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File: USOC

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DOCUMENT-IDENTIFIER: US 2922947 A

TITLE: Gyromagnetic resonance apparatus

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to siicl detecting means which is frequency-related to the driving radio frequency field.and with controllable phase relative thereto whereby one of the phase components of the detected re@onance signal may be rendered dominant. 19. Gyromagnetic resonance apparatus wherein gyromagnetic resonance of atom portions possessing the properties of magnetic moment and gyroscopic moment may be produced and detected which comprises means for producing a magnetic field for polarizing said atom portions, means for supplying driving radio frequency magnetic field energy to said atom portions to produce gyromagnetic resonance of the atom portions in the polarizing magnetic field, said energy supplying means comprising a plurality of coils positioned mutually perpendicular to each other and connected in series, each coil having a volume of matter including said portions of atoms associated therewith, said coils being inductively coupled to the atom portions of its associated volume of matter, generator. means coupled to said field producing means for supplying a squarewave to modulate the polarizing field to thereby cause said resonance to occur periodically during only one-half of each square wave cycle, means for detecting the resonance signal resulting from the gyromagnetic resonance of the atom portions, means for supplying a reference radio frequency ener.-Y to said detecting means which is frequency-related to the drivin.- radio frequency field and with controllable phase relative thereto whereby one of the components of the detected resonance signal may be rendered dominant, and means for coupling said square wave generator to said detecting means whereby a voltage outi)ut may be obtained from the detecting means in which the magnitude of the output is proportional to the degree that the frequency of the received signal varies from the frequency of the maximlim resonance signal and the sign of which is dependent on whether the received signal has a frequency higher or lower than the frequency of maximum resonance. 19. Apparatus wherein gyromagnetic resonance of atom portions possessing the properties of magnetic moment and gyroscopic moment may be produced and detected which comprises means for producing a magnetic field for pola,rizing said atom portions, means for supplying driving radio frequency magnetic field energy to said atom portions to produce gyromagnetic resonance of the atom portions in the polarizing magnetic field, said energy supplying means comprising a plurality of coils positioned mutually perpendicular to each other and connected in series, each coil having a volume of matter including said portions of atoms associated therewith, said coils being inductively coupled to the atom portions of its associated 12 volume'of matter, generator means coupled to said field producing means for supplying a square wave to modulate the polarizing field to thereby cause said resonance to oc@-,ur periodically during only one-half of each square wave cydle, means for detecting the resonance signal resulting from the gyromagnetic resonance of the atom portions comprising a receiver for amplifying the resonance signal, @i first phase sensitive detector circuit coupled to the output of said receiver, means including a phase shifter net- 10 work coupling the transmitter to the first phase detector for supplying a reference radio frequency energy to said first detector which is frequency-related to the radio frequency in the transmitter and with controllable phase relative thereto whereby one of the components of the de- 15 te@,ted resonance signal may be rendered dominant, and a second phase sensitive detector circuit coupled to the output of said first detector and to the square wave generator, the output of said second phase sensitive detector being a direct current voltage, the magnitude of which is 20 proportional to the degree that the frequency of the received signal varies from the frequency of the maximum resonance signal and the sign of which is dependent on whether the received signal has a frequency higher or lower than the frequency of maximum resonance. 25 20. A sensing head for use in the detection of g yromagnetically precessing atom portions in magnetic fields which comprises a plurality of electrical coils positioned mutually perpendicular to each other and connected in series, each coil being electromagnetically coupled to mat- 30 ter containing said gyromagnetic atom portions, said portions of atoms having properties of magnetic moment and gyroscopic moment and being capable of precessing in magnetic fields in response to electromagnetic field energy applied to said matterand terminals on said serially con- 35 nected coils for coupag

electromagnetic energy from said coils due to said precessing atom portions. References Cited in the file of this patent UNITED STATES PATENTS 40 2,561,489 Bloch et al - ----- July 24, 1951 2,589,494 Hershberger ----- Mar. 18,1952 OTHER REFERENCES Packard: Review of Scientific Instruments, vol. 19, No. 45 7, July 1948, pp. 435-439. Levinthal: Physical Review, vol. 78, No. 3, pp. 204-213, May 1, 1950. Andrew: Nuclear Magnetic Resonance, published 1955 50 by Cambridge Press.

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